

CLAIMS

1. A carrier for high pressure treatment of a substance comprising:
an enclosure defining a chamber into which is placed a substance to be treated with high pressure, the enclosure having outer side walls, a top closure and a floor to define an outer surface of the enclosure that is substantially fluidically closed, a quantity of insulating material being provided around an inner region of the enclosure, and wherein a pressure media entry port is provided in the enclosure and a vent is provided in an upper region of the enclosure.
2. The carrier according to claim 1 wherein the insulating material has substantially high adiabatic heating properties.
3. The carrier according to claim 2 wherein the insulating material exhibits an adiabatic compression temperature change of substantially 3-10°C for a 100 MPa pressure change.
4. The carrier according to claim 1 wherein the insulating material is polyethylene, polypropylene, polyvinyl chloride, rubber, or any other low conductivity material.
5. The carrier according to claim 1 wherein the outer side walls and floor are formed of a rigid material.
6. The carrier according to claim 5 wherein the rigid material is stainless steel.
7. The carrier according to claim 1 wherein the pressure media entry port is provided in the floor of the enclosure.

8. The carrier according to claim 7 wherein a check valve is positioned in the pressure media entry port.

9. The carrier according to claim 1 wherein the vent is of sufficiently small dimension relative to a size of the enclosure to reduce convection currents in the chamber when pressure media is introduced into the chamber through the pressure media entry port.

10. The carrier according to claim 1, further comprising a plurality of grooves provided in the insulating material to assist the distribution of pressure media when pressure media is introduced into the chamber through the pressure media entry port.

11. An assembly for pressure processing a substance comprising:
an ultrahigh-pressure vessel;
a source of ultrahigh-pressure fluid in selective fluid communication with the ultrahigh-pressure vessel; and
a product carrier that is selectively placed into and removed from the ultrahigh-pressure vessel, the product carrier being insulated by a quantity of insulating material.

12. The assembly according to claim 11 wherein the insulating material has substantially high adiabatic heating properties.

13. The assembly according to claim 11 wherein the insulating material exhibits an adiabatic compression temperature change of substantially 3-10°C for a 100 MPa pressure change.

14. The assembly according to claim 11 wherein the insulating material is polyethylene, polypropylene, polyvinyl chloride, rubber, or any other low conductivity material.

15. The assembly according to claim 11 wherein outer side walls and a floor of the product carrier are formed of a rigid material.

16. The assembly according to claim 15 wherein the rigid material is stainless steel.

17. The assembly according to claim 11 wherein pressure media entry ports are provided in a floor of the product carrier.

18. The assembly according to claim 17 wherein a check valve is positioned in each pressure media entry port.

19. The assembly according to claim 11 wherein the product carrier is provided with a vent.

20. The assembly according to claim 19 wherein the vent is in an upper region of the product carrier and the vent is of sufficiently small diameter to reduce convection currents in the product carrier when ultrahigh-pressure fluid is allowed to flow into the product carrier.

21. The assembly according to claim 11, further comprising a plurality of grooves provided in the insulating material to assist the distribution of pressure media when pressure media is introduced into the product carrier.

22. The assembly according to claim 11, further comprising a preheating apparatus, the product carrier being selectively placed into and removed from the preheating apparatus prior to being placed into the ultrahigh-pressure vessel.

23. The assembly according to claim 22, further comprising a transport mechanism removably coupled to the product carrier, the transport mechanism selectively

moving the product carrier into and out of the preheating apparatus and into and out of the ultrahigh-pressure vessel, and selectively moving the product carrier between the preheating apparatus and the ultrahigh-pressure vessel.

24. The assembly according to claim 23 wherein the transport mechanism is insulated.

25. The assembly according to claim 22, further comprising heating elements coupled to the ultrahigh-pressure vessel.

26. The assembly according to claim 25, further comprising a cooling apparatus, the product carrier being selectively placed into and removed from the cooling apparatus after the product carrier is subjected to pressure in the ultrahigh-pressure vessel.

27. The assembly according to claim 22, further comprising a cooling apparatus, the product carrier being selectively placed into and removed from the cooling apparatus after the product carrier is subjected to pressure in the ultrahigh-pressure vessel.

28. The assembly according to claim 11, further comprising heating elements coupled to the ultrahigh-pressure vessel.

29. The assembly according to claim 28, further comprising a cooling apparatus, the product carrier being selectively placed into and removed from the cooling apparatus after the product carrier is subjected to pressure in the ultrahigh-pressure vessel.

30. The assembly according to claim 11, further comprising a cooling apparatus, the product carrier being selectively placed into and removed from the cooling apparatus after the product carrier is subjected to pressure in the ultrahigh-pressure vessel.

31. The assembly according to claim 11, further comprising a plurality of thermocouples coupled to the carrier to monitor an internal temperature of the vessel.

32. An assembly for pressuring processing a substance comprising:

an ultrahigh-pressure vessel including a heating element coupled to the ultrahigh-pressure vessel, the heating element allowing the ultrahigh-pressure vessel to be preheated to a selected temperature;

a source of ultrahigh-pressure fluid in selective fluid communication with the ultrahigh-pressure vessel; and

a product carrier that is selectively placed into and removed from the ultrahigh-pressure vessel, the product carrier being provided with a pressure media entry port to allow ultrahigh-pressure fluid to flow into the product carrier when the ultrahigh-pressure fluid is in fluid communication with the ultrahigh-pressure vessel.

33. The assembly according to claim 32, further comprising a preheating apparatus, the product carrier being selectively placed into and removed from the preheating apparatus prior to being placed into the ultrahigh-pressure vessel.

34. The assembly according to claim 33, further comprising a transport mechanism removably coupled to the product carrier, the transport mechanism selectively moving the product carrier into and out of the preheating apparatus and into and out of the ultrahigh-pressure vessel, and selectively moving the product carrier between the preheating apparatus and the ultrahigh-pressure vessel.

35. A method for pressure processing a product comprising:

loading the product into a product carrier insulated with a material having substantially high adiabatic heating properties;

inserting the product carrier and the product contained therein into an ultrahigh-pressure vessel;

pressurizing the product carrier and its contents with a volume of pressure media for a selected period of time; and
removing the product carrier from the ultrahigh-pressure vessel.

36. The method according to claim 35, further comprising:
preheating the product in the product carrier to a selected temperature;
preheating the ultrahigh-pressure vessel to the selected temperature; and
preheating the pressure media to the selected temperature, prior to pressurizing the product carrier.

37. The method according to claim 36, further comprising:
insulating an exterior surface of the product carrier as it is moved from a preheating apparatus to the ultrahigh-pressure vessel.

38. The method according to claim 35, further comprising:
preheating the ultrahigh-pressure vessel to a first temperature that is higher than an initial temperature of the product prior to pressurizing the product carrier.

39. The method according to claim 38 wherein the first temperature is equal to the expected temperature of the product when pressurized.

40. The method according to claim 35, further comprising:
adding a quantity of pressure media into the product carrier with the product prior to inserting the product carrier into the ultrahigh-pressure vessel.

41. A method for pressure processing a product comprising:
loading the product into a product carrier that is insulated and substantially fluidically closed;

preheating the product, an ultrahigh-pressure vessel and a volume of pressure media to a selected temperature;

inserting the product carrier into the ultrahigh-pressure vessel;

allowing pressure media to flow into the product carrier;

pressurizing the product carrier with the pressure media for a selected period of time; and

removing the product carrier from the ultrahigh-pressure vessel.

42. The method according to claim 41, further comprising:

insulating an exterior surface of the product carrier as the product carrier is moved from a preheating apparatus to the ultrahigh-pressure vessel.

43. The method according to claim 41, further comprising:

adding a quantity of pressure media into the product carrier prior to inserting the product carrier into the ultrahigh-pressure vessel.

44. A method for pressure processing a product comprising:

loading the product into a product carrier;

closing the product carrier to substantially prevent the flow of pressure media into and out of the product carrier except through selected pressure media entry ports;

inserting the product carrier into an ultrahigh-pressure vessel;

pressurizing the product carrier for a selected period of time; and

removing the product carrier from the ultrahigh-pressure vessel.

45. The method according to claim 44, further comprising:

inserting the product carrier into the ultrahigh-pressure vessel and substantially simultaneously allowing a volume of pressure media to enter the pressure vessel.

46. The method according to claim 45, further comprising:
adding a quantity of pressure media in the product carrier prior to inserting the product carrier into the ultrahigh-pressure vessel.

47. The method according to claim 45, further comprising:
preheating the ultrahigh-pressure vessel to a first temperature that is higher than an initial temperature of the product prior to pressurizing the product carrier.

48. The method according to claim 44, further comprising:
adding a quantity of pressure media in the pressure carrier prior to inserting the product carrier into the ultrahigh-pressure vessel.

49. A method for pressure processing of product comprising:
loading the product into a product carrier;
preheating the product, an ultrahigh-pressure vessel and a volume of pressure media to a selected temperature;
inserting the product carrier into the ultrahigh-pressure vessel;
pressurizing the product with the pressure media for a selected period of time;
removing the product carrier from the ultrahigh-pressure vessel;
evacuating the pressure media from the ultrahigh-pressure vessel to a reservoir;
reheating the pressure media in the reservoir to a selected temperature; and
allowing the pressure media from the reservoir to flow into the pressure vessel for treatment of a second batch of product.

50. The method according to claim 49, further comprising:
closing the product carrier to substantially prevent the flow of pressure media into and out of the product carrier except through one or more selected pressure media entry ports.

51. The method according to claim 50, further comprising:

adding a quantity of pressure media into the product carrier prior to inserting the product carrier into the ultrahigh-pressure vessel.

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